Docket 87-268

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

NATIONAL INFORMATION INFRASTRUCTURE

AND

GRAND ALLIANCE HDTV SYSTEM

INTEROPERABILITY

FEBRUARY 22, 1994

The purpose of this paper is to: 1) provide an overview of the issues involved in the design of a digital HDTV system, 2) to summarize the interoperability characterisctics of the Grand Alliance HDTV system that are most relevant to the NII, and 3) to address some of the options that might be considered by policy makers, in order to form the basis for an ongoing constructive dialog among concerned parties.

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1. OVERVIEW

The design of a digital HDTV system involves complex and interrelated tradeoffs that achieve a balance among many different requirements which are often in conflict with each other. In addition, achieving interoperability with a diverse collection of other television, imaging and information systems is difficult due to the proliferation of different standards in some industries, and the lack of standards in others.

THE U.S. HAS ESTABLISHED WORLDWIDE LEADERSHIP IN DIGITAL HDTV

In 1987, the FCC established an Advisory Committee on Advanced Television Service (ACATS) to recommend a new television standard for the United States. In a highly competitive process, industry responded with over twenty systems, which were reduced to a smaller field of feasible contenders by thorough review during the following two years. These early systems were either analog or hybrid analog and digital approaches. After the FCC clearly stated its desire for a simulcast HDTV system in early 1990, the rapid announcement of four digital HDTV systems followed. The competing systems were officially tested and extensively analyzed during 1992, leading to an ACATS recommendation that a digital HDTV system be adopted for the U.S. It was also recommended that the competing systems should either be improved and retested, or somehow combined. In mid-1993, the former competitors joined in a Grand Alliance beginning a collaborative effort with the Advisory Committee to create the best possible HDTV system for the United States. These developments suddenly vaulted the U.S. into a world-leading technological position in an area where many had considered us hopelessly behind. Now, with the rest of the world attempting to catch up, rapid standardization and deployment of digital HDTV is necessary to reap an economic reward.

SIMULCAST REQUIREMENTS ARE UNIQUE AND TECHNICALLY DEMANDING

The worldwide technological lead established by U.S. industry in digital HDTV resulted from the **simulcast** principle that was set forth by the FCC in early 1990. Simulcasting means that programming is simultaneously broadcast in both NTSC and HDTV, on different channels. This approach allows a smooth transition to HDTV while maintaining service to the installed base of NTSC receivers, which will gradually be phased out of existence. Since no additional radio frequency spectrum is readily available for HDTV broadcasting, two crucial technical requirements emerge:

- High quality HDTV programs must be delivered in a 6 MHz television channel, in order to make efficient use of spectrum and fit allocation plans for spectrum assigned to television broadcasting.
- A restricted-power signal must be used so that simulcasting in the same frequency allocations as current NTSC service does not cause excessive interference to the existing NTSC audience. The channels that are available for simulcast are generally unsuitable for broadcasting an NTSC signal, because too much interference with other stations would result.

These objectives are so difficult that they could not be achieved with state-of-the-art analog television approaches, which resulted in the emergence of all-digital HDTV system proposals. *These objectives are also so difficult that they can barely be achieved even with digital technology*. The reason for this is that the objectives, high quality HDTV and restricted-power simulcasting, are fundamentally in tension with each other:

- High quality digital HDTV benefits from as high a bit rate as possible. The ≈19 Mbps data rate of the Grand Alliance system could not be reduced without causing an adverse impact on picture quality.
- Achieving a higher data rate requires either:
  - more than 6 MHz of spectrum, which is unavailable
  - higher transmitted signal power, which would result in unacceptable interference

The Grand Alliance HDTV system represents a careful balance of many tradeoffs that have been made to meet the demanding requirements of HDTV simulcasting.

CONSUMER MARKETS REQUIRE LOW COST

Successful development of a consumer market requires that HDTV receivers and services are affordable by most households.

Accounting for likely advances in integrated circuit speed, density and cost, current estimates are that an HDTV receiver will have a $1,000 - $2,000 premium over today's large-screen television sets. Since this places the cost of an HDTV receiver in the $3000 - 4,000 range, it is safe to say that significant cost reduction must occur before HDTV becomes a mass market product, and that adding fuctionality that further increases cost runs the risk of making HDTV products so expensive that the market is never created. Likewise, practical and cost effective delivery of HDTV through cable television is consistent with many simulcasting requirements, particularly the need for efficient use of spectrum. Bandwidth (i.e., data rate) is never free, and providing HDTV service to cable subscribers at low cost requires using as low a data rate as possible.

INTEROPERABILITY IS A COMPLEX BALANCE OF CONFLICTING REQUIREMENTS

Interoperability has been officially recognized as one of the important design goals for an HDTV system since 1990, when the competitive digital systems were undergoing development. As planning for the National Information Infrastructure (NII) proceeds, some policy makers have raised questions about the relationship between the NII and HDTV. Even considering interoperability alone, establishing the best HDTV system for the U.S. requires balancing many different (and often conflicting) interoperability considerations that relate to broadcasting, cable television and consumer electronics, as well as computing, telecommunications and the NII.

There are many currently existing and emerging systems and standards with which it is necessary to interoperate. Unfortunately, these systems are not particularly interoperable with one another, yet they each demand interoperability with HDTV. Achieving simple interoperability with all of these systems is clearly impossible. Fortunately, achieving interoperability between any given standards or systems is only a question of relative ease -- anything can be made to interoperate with enough interfacing electronics. Therefore, interoperability is always an issue of *degree*.

For example, there are a large number of existing and emerging formats in today's growing world of imaging, and choosing a single format to interoperate with all of them is impossible. Perhaps the three most important formats that an HDTV system must work well with in order to be successful are HDTV Production, Film and NTSC (including CCIR-601 component video). It is notable that these widely accepted standards have different pixel formats, different scanning approaches (i.e., interlaced and progressive) and different frame rates. Nonetheless, the film and television industry have developed techniques to achieve interoperability among these standards with appropriate converters. **On the other hand, computer formats pose a much greater interoperability difficulty, since there is no industry-wide display standard, and virtually every vendor continually introduces unique formats and frame rates.** While computer formats are uniform in their use of square pixels and progressive scanning, the vendors' various pixel formats and frame rates are unrelated, and no simple technique of converting among them is commonly available.

Likewise, there are a variety of existing networking protocols and standards that are not simply related. Data communications standards like Ethernet, FDDI and Internet use different packet sizes, formats and protocols, and require interface electronics to "bridge" networks. Emerging telephony standards such as ATM use still different packet sizes, formats and protocols that provide many advanced capabilities for voice, but do not directly meet the needs of either video or data transmission.

SUMMARY

Designing a digital HDTV system inevitably requires balancing the degree of interoperability of one kind versus interoperability of another kind, with the constraint that a functional, efficient standard must be developed. As will be explained in the following chapter, the Grand Alliance HDTV system has paid particular attention to achieving interoperability with the NII by providing "computer-friendly" square pixel and progressive scan formats, and an "ATM-friendly" packet format that is simply related to ATM packets.

Of course, interoperability itself must be balanced against other design goals such as HDTV picture quality, restricted-power simulcasting and low cost. Fortunately, digital technology makes it possible to meet many of these diverse considerations with a single, highly flexible system design. The final judge of success, however, will be the consumer -- HDTV must ultimately be affordable and compelling, or it will not become a mass market product.

The ACATS and the Grand Alliance have carefully balanced many considerations, which often have conflicting technical demands. The Grand Alliance HDTV system is the best available solution that satisfies the requirements and constraints of an HDTV system that can be delivered now by broadcast and cable transmission to consumer-affordable receivers, while simultaneously providing a high degree of interoperability with computing and telecommunications.

2. GRAND ALLIANCE HDTV SYSTEM INTEROPERABILITY

While meeting other requirements, the Grand Alliance HDTV system is designed to provide broad interoperability with computers, telecommunications and other key elements of the NII.

SYSTEM ARCHITECTURE APPROACH IS CONSISTENT WITH COMPUTER SYSTEMS

The Grand Alliance HDTV system employs two fundamental system principles that make it a highly interoperable system. First, it is designed with a layered digital system architecture which is compatible with the international Open Systems Interconnect (OSI) model of data communications that forms the basis of virtually all modern digital sytems. In addition, each individual layer of the system is designed to be interoperable with other systems at corresponding layers, which means that many different applications can make use of various layers of the HDTV architecture. Secondly, the Grand Alliance HDTV system takes full advantage of the potential flexibility offered by a digital approach by using header/descriptor approach that allows maximum flexibility to be achieved.

The Grand Alliance HDTV system is a layered digital system that consists of four primary layers:

- the Picture layer provides multiple picture formats and frame rates (supported by header/descriptors at the compression layer)
- the Compression layer is based on MPEG-2 video compression
- the Transport layer is a packet format with packet header/descriptors that is based on MPEG-2 transport, and provides the flexibility to deliver a wide variety of picture, sound and data services
- the Transmission layer is a signal that delivers a net data rate of approximately 19 Mbps in the 6 MHz simulcast channel

Interoperability aspects of each layer that are relevant to the NII will be discussed in the following sections.

EXTENSIVE PROGRESSIVE SCAN AND SQUARE PIXEL CAPABILITES ARE PROVIDED

The picture layer consists of the pixel formats delivered by the system. A pixel format is usually described as (number of pixels horizontally) x (number of lines vertically). The HDTV transmission standard must strive to be easily interoperable with a plethora of existing pixel formats, including those used in personal computers and workstations, motion picture film, currently available HDTV production equipment and the current NTSC television standard. These currently existing pixel formats all meet specific needs of a particular company or industry, and often have little in common. For example, almost all computers use square pixels progressive scanning, although there is no single (or even predominant) industry standard. Television, on the other hand, uses rectangular pixels and interlaced scanning, but has an international standard (CCIR 601) that provides a 720 x 488 pixel format. Fortunately, there is a large body of existing techniques for converting from one pixel format to another, and such conversions are commonly performed in television and film production.

In computers and other systems that are not limited by transmission data rate (i.e., bandwidth or power), there is no doubt that progressive scanning at a high frame rate is the preferred approach. This is the fortunate situation for computer applications where text and graphics rendition dominates the system requirements. HDTV is a very different situation, since the available data rate is so limited that extensive digital compression is required. **Unfortunately, the ≈19 Mbps data rate that is available in the 6 MHz simulcast channel is inadequate to transmit a high resolution 1920 x 1080 format image progressively scanned at 60 frames/sec.** Therefore, some aspect of picture performance must be compromised to fit in the available data rate of the simulcast channel.

The choices are: 1) to reduce picture resolution, 2) to reduce frame rate, 3) to tolerate increased compression artifacts (noise and blockiness), or 4) to tolerate certain interlace artifacts such as interline flicker. **No one choice is best for all types of picture material.** Since no single tradeoff is best for all applications or types of picture material, the Grand Alliance has chosen to support two different pixel formats and three different frame rates, resulting in six combinations of pixel format and frame rate that can produce acceptable picture quality at the available 19 Mbps data rate. Recognizing the many advantages of progressive scan, this attribute is used in five of the six combinations of pixel format and frame rate.

The two pixel formats provided by the Grand Alliance HDTV system are 1920 x 1080 and 1280 x 720. Each format has a wide 16 x 9 aspect ratio, with square pixels that are extremely important for computer interoperability. It is noteworthy that this choice represents a preference for computer interoperability over interoperability with the current NTSC television standard, since digital representations of NTSC have non-square pixels. The two Grand Alliance pixel formats have been chosen to be simply related by a factor of 3:2, and converting between them requires a simple interpolation filter. The Grand Alliance pixel formats likewise have another 3:2 relationship to the common 640 x 480 VGA computer format (note that VGA is a narrower 4 x 3 aspect ratio), providing simple interoperability with VGA format text and graphics.

In order to be flexible and interoperable with television, film and computers, the Grand Alliance HDTV system provides three different frame rates: 60, 30 and 24 Hz. All combinations of pixel format and frame rate are progressively scanned except for the highest combination (1920 x 1080 at 60 Hz), which is interlaced, but retains square pixels. An interlaced format is preferred for some types of picture material, such as that used for much entertainment television, and it also provides interoperability with existing interlaced sources. Just as conversions can be performed among various pixel formats, an interlaced scan can be converted to progressive scan by a de-interlacing filter that "fills in" the missing lines.

The Grand Alliance HDTV system thus provides for multiple formats and frame rates, *all of which will be decoded by any Grand Alliance HDTV receiver.* In summary, the combinations of pixel format and frame rate are shown below:

Spatial Format (X x Y active pixels)	Temporal rate
1280 x 720 (square pixels)	24 Hz progressive scan
	30 Hz progressive scan
	60 Hz progressive scan
1920 x 1080 (square pixels)	24 Hz progressive scan
	30 Hz progressive scan
	60 Hz interlaced scan

The flexible format/frame rate transmission approach of the Grand Alliance accommodates various production standards that enables different industries, program producers, application developers and users to make their own tradeoffs among resolution, frame rate, compression artifacts and interlace artifacts, by choosing the format/frame rate combination that provides the best picture quality for their particular use. It also gives receiver manufacturers the flexibility to produce a wide variety of products that have different functionality and cost, and consumers the freedom to choose among them.

A Migration to All Progressive Scan Formats is Planned

Clearly, a 1920 x 1080 progressive scan format at 60 Hz would be highly desirable, since it simultaneously has both the highest spatial resolution and the highest frame rate. The inability to deliver this format and frame rate is a result of the data rate limitations imposed by the simulcast requirement and current compression technology. Clearly, compression will continue to improve as computing power becomes more affordable, and as practical experience is gained by the developers of commercial encoding equipment. However, compression advances alone may not be enough to allow a high-quality 1920 x 1080 progressive scan format at 60 Hz to be transmitted in ≈19 Mbps. Additional data rate for an "enhancement" bit stream will most likely be required to compatibly upgrade any (or all) of the initial formats to the full 1920 x 1080 60 Hz progressive performance. The combination of increased compression performance and additional data rate can reasonably be expected to enable the migration to all-progressive formats.

As NTSC audience share declines, and interference into NTSC service is of lesser concern, the opportunity to compatibly increase the data rate of the simulcast channel is created. At a minimum, NTSC channels can be allocated to such purposes as they go off-air. A more aggressive timetable can be obtained by compatibly increasing the data rate of the simulcast signal and tolerating a higher level of interference with NTSC service, as its audience diminishes. The ACATS and Grand Alliance are committed to work with the FCC and broadcasters to develop a practical technical approach and timetable for this migration to all progressive formats.

COMPRESSION CONFORMS TO THE INTERNATIONAL MPEG-2 STANDARD

The compression layer of the Grand Alliance HDTV system transforms the raw video and audio samples into a coded bit stream -- essentially a set of data and computer instructions that are executed by the receiver to recreate the pictures and sound. At the compression layer, the Grand Alliance HDTV system has attributes that contribute to interoperability with the compression syntax that will be commonly used by computers and multimedia systems.

The Grand Alliance video compression syntax is based on the ISO-MPEG (International Standards Organization — Moving Picture Experts Group) MPEG-2 video data compression draft standard. The Grand Alliance's use of MPEG-2 video compression fundamentally enables HDTV devices to interoperate with MPEG-2 and MPEG-1 computer multimedia applications directly at the compressed bit stream format. For example, this means that consumer HDTV VCRs can produce an output bit stream that can be input to a multimedia computer, and that HDTV receivers can be interfaced to CD-ROMs containing full-motion video. Obviously, appropriate interfaces must be specified, but a common compression standard clearly facilitates interoperability.

THE TRANSPORT LAYER USES A POWERFUL, PACKETIZED DATA APPROACH

The transport layer of the Grand Alliance HDTV system encapsulates the video and audio bitstreams into fixed-size transport packets. This packetization serves many purposes: it packages the data into fixed-size units suitable for Forward Error Correction encoding (FEC), it multiplexes the various elements of the program (video, audio, data, etc.), it provides time synchronization for those elements, and through the use of packet identifiers (PID) in header/descriptors, it provides flexibility and extensibility with backward compatibility. As shown in Figure 1, the HDTV data consists of a stream of packets, where each packet contains a single type of data (video, audio, program guide, etc.) identified by the packet's ID number, the PID. There is no predetermined mix of data required, and furthermore the mix can change *dynamically* from moment to moment.

video	TEXT	video	audio 1	video	video	audio 2	video	video	PGM GD	video

Figure 1 - The Grand Alliance HDTV System separately packages video, audio and auxiliary data in fixed-length packets. This enables data multiplexing, Forward Error Correction, time synchronization, and extensibility with backward compatibility.

This packet structure allows great flexibility in the services that can be provided. For example, a secondary video program can be introduced, such as another camera angle during a baseball game, that would appear in a window on the receiver at the viewer's option. Multiple language broadcasts can be facilitated through the introduction of a new audio packet stream. Program-related software can be downloaded to "smart receivers". Pay-per-view television can be serviced through decoder addressing and scrambling control bits. A significant portion of the channel capacity can be momentarily diverted for use other than video, such as to provide rapid addressing of subscriber terminals, during periods of relatively easy-to-compress images (e.g. stills).

MPEG-2 TRANSPORT IS USED RATHER THAN ATM FOR FUNDAMENTAL REASONS

The transport layer is an important element of interoperability, since it defines the basic format of data packets . Again in conformance with international standards, the Grand Alliance has adopted the MPEG-2 transport draft standard. This choice was not an uninformed one. It is clear that for voice and data communications over wired networks, the Asynchronous Transfer Mode (ATM) protocol is rapidly being adopted by the computer and telecommunications industries. The emergence of these two different packet formats occurred because ATM was designed for the "link layer" of the OSI model, and it does not provide capabilities that are necessary for video transmission.

ATM is not used either in the Grand Alliance HDTV system or MPEG-2 for two fundamental reasons: 1) its overhead is too high, and 2) it does not provide certain capabilities that are essential for video. However, a great deal of attention has been placed on achieving interoperability between MPEG-2 and ATM. ATM can carry MPEG-2 data streams, and MPEG-2 can carry ATM data streams.

The terrestrial broadcast channel is limited in data rate and subject to severe error rates under poor reception conditions. As previously explained, in the regime of ≈19 Mbps, HDTV picture quality is extremely sensitive to any decrease in data rate. Therefore, the picture quality performance of an HDTV simulcast system is substantially affected by transport overhead (header-to-payload size ratio) and error correction overhead.

ATM's short 53 byte packet size (which is necessary for voice telephony that it was designed to support) results in a large header overhead: the 5 byte ATM header comprises about 10% of the bits that make up its packet stream. This level of overhead is very wasteful of precious bits in a situation where the channel is bit-limited and the picture quality is very sensitive to bit rate. Consider that in a channel of approximately 19 Mbps capacity, the loss of about 1.9 Mbps of data rate would result in a significant degradation in picture quality. A longer packet size with lower overhead is clearly desirable from a picture quality point of view.

The packetized data must survive transmission under poor conditions, so the overhead due to Forward Error Correction (FEC) coding is also a concern. Reed-Solomon (or other block-based) FEC codes are more powerful and efficient when applied to longer packets, so the selection of longer packets also provides increased transmission robustness. Stated another way, for a given error correction capability, a longer packet size requires less FEC overhead than a shorter packet. Once again, reducing overhead in order to improve picture quality is an overriding consideration.

Finally, the ATM protocol, designed for generic telecommunications, does not provide certain television-related services that are essential for an HDTV system, such as timing recovery, media synchronization, and encryption control. This situation is not the conundrum that it seems. MPEG-2 and ATM are, in fact, complementary. Each was designed in accordance with the international ISO Open Stytem Interconnect (OSI) layered data communications model. MPEG-2 was designed to provide functionality from the application layer down through the link layer, while ATM was designed to provide link and network layer functionality. Although MPEG-2 and ATM each provide certain link layer functions, they are quite separable, and they can work separately or together. MPEG-2 is self-sufficient for broadcasting applications, while ATM provides additional functions needed for point-to-point communications.

MPEG-2 TRANSPORT IS "ATM-FRIENDLY"

The Grand Alliance has chosen to use a fully compatible subset of the MPEG-2 Systems Transport. The Grand Alliance (MPEG-2) packet is 188 bytes long, consisting of 184 bytes of payload and 4 bytes of header, as shown in Figure 2. The header contains the packet sync byte, a 13-bit service identifier (PID), a 4-bit continuity counter to help in the event of packet loss or mis-ordering, bits for control of scrambling systems (e.g. pay-per-view) and an optional priority bit to indicate the relative priority of the data. The PID header provides the important capability to combine multiple video, audio and ancillary data steams into a single related program stream. The payload may optionally contain an Adaptation Header (which is counted as part of the 184-byte payload). The Adaptation Header contains information to distribute timebase reference to decoders, indicate random access locations for decoders, and to indicate bit stream splice points for affiliate/head-end insertion equipment. The Adaptation Header also provides the facility for sending private user data, such as conditional access messages.

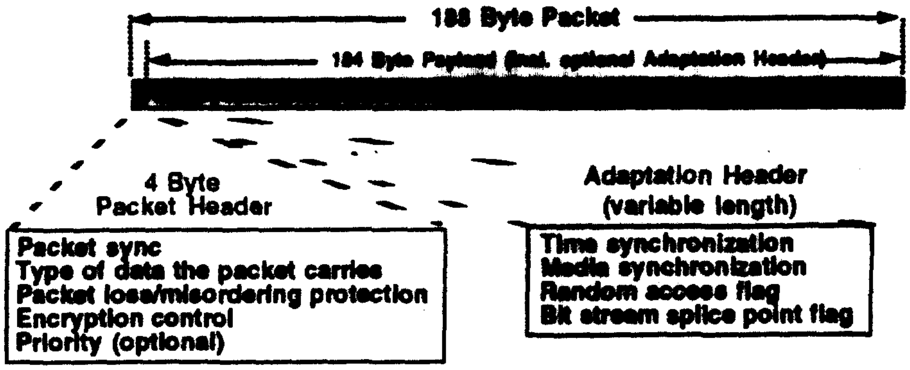

Figure 2. The Grand Alliance (MPEG-2) packet: The Grand Alliance (MPEG-2) packet is 188 bytes long consisting of 184 bytes of payload and 4 bytes of header. The payload may optionally contain a Adaptation Header (which is counted as part of the 184-byte payload). The packet length was chosen to interoperate with ATM using a 4:1 ratio.

Simple interoperability between the Grand Alliance/MPEG-2 Transport and ATM has been provided for by designing the MPEG-2 packet length to have a 4:1 relationship to ATM. The ATM format, designed for voice telephony, provides certain extensions for carrying other types of data called ATM Adaptation Layers (AAL). As shown in Figure 3, the Grand Alliance/MPEG-2 packet may be encapsulated within four ATM packets that each use 1 ATM AAL byte (to describe the encapsulation), which leaves 47 usable payload bytes per ATM packet. Since 4 x 47 is 188, this provides an exact fit for the entire Grand Alliance/MPEG-2 packet. An important advantage of encapsulation is that it retains the full functionality of both the MPEG-2 Transport stream (for video-related capabilities) and the ATM transport stream (for network connection management), each defined by their own headers. This is crucial, since ATM does not provide the necessary capabilities for compressed video delivery. The careful relationship between MPEG-2 and ATM ensures that MPEG-2 video streams can be efficiently carried over ATM links with no loss of functionality.

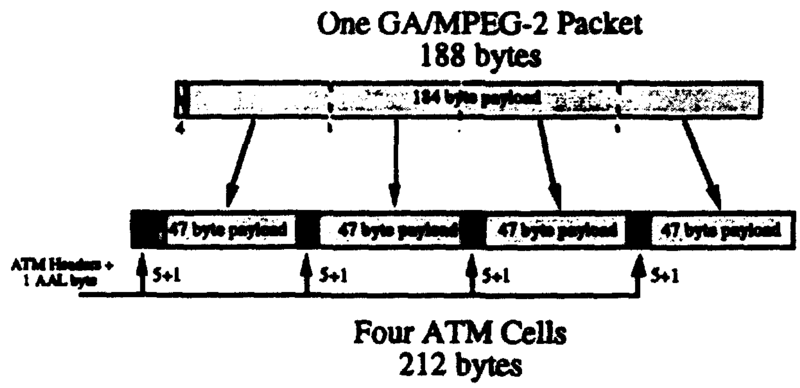

Figure 3. Encapsulation of Grand Alliance/MPEG-2 within ATM. A Grand Alliance/MPEG-2 packet may be encapsulated complete with its header within four ATM packets by using 1 AAL byte per ATM Header leaving 47 usable payload bytes x 4 packets for 188 bytes. Encapsulation concatenates the full functionality of the MPEG-2 Transport stream with the full functionality of the ATM transport stream.

While the delivery of MPEG-2 applications over ATM links will likely be the most common interoperability scenario, the opposite situation of delivering ATM data over an MPEG-2 link also deserves consideration. In this case, 7 ATM packets may be encapsulated within 2 MPEG-2 packets by discarding one of certain ATM header bytes which can be recomputed and reinserted when the ATM data is extracted from the MPEG-2 packet. Discarding one header byte yields a 52 byte ATM packet. Since 7 x 52 = 364 and 2 x 184 = 368, 4 bytes of "padding" are introduced in this conversion, a small inefficiency price to pay for achieving interoperability in this direction. Again, note that the full functionality of both the MPEG-2 Transport stream and the ATM transport stream are preserved by this approach.

TRANSMISSION INTEROPERABILITY IS ACHIEVED THROUGH A SERIAL BIT STREAM

Interoperability at the transmission layer is facilitated by the nature of digital systems. Although different modulation techniques are used to meet the characteristics of different physical channels (e.g., terrestrial simulcast, cable, satellite, fiber, etc.), demodulation into the serial bit stream forms the basis for transcoding among modulation techniques and achieving interoperability among different physical delivery media.

SUMMARY -- THE GRAND ALLIANCE HDTV SYSTEM IS NII-READY

The Grand Alliance HDTV system provides interoperability with the NII by using:

- A layered digital system architecture that conforms to international data communications models
- Header/descriptors that allow a flexibile system today and extensibility for future improvements
- Multiple video formats and frame rates with a heavy empahsis on progressive scan and square pixel formats that faciliate simple computer interoperability
- MPEG-2 video compression that conforms to draft international standards, and that will likely form the basis for most computer multimedia use of motion video
- MPEG-2 transport (packet) format that meets the needs of broadcasting while being designed to be easily interoperable with ATM, an important networking component of the NII.

The Grand Alliance HDTV system has carefully balanced technical considerations with national and international standards in reponse to diverse requirements from broadcasting, cable television, consumer electronics, computing and telecommunications to provide a highly interoperable system. Adoption of the Grand Alliance HDTV system by the FCC will result in a new generation of entertainment television systems and products, and it will also advance the convergence of television and NII applications, provide HDTV/NII terminals with great consumer appeal, and accelerate the deployment and adoption of the NII.

3. POLICY CONSIDERATIONS

The Grand Alliance HDTV system represents a balance of many considerations. It achieves the extremely difficult goal of simulcast delivery, which allows HDTV to be delivered without the allocation of additional radio frequency spectrum. Other policy alternatives have substantial ramifications.

ABANDONING TERRESTRIAL BROADCASTING DIMINISHES PUBLIC SERVICE

One response to the technical constraints imposed by HDTV simulcasting is to question the value of terrestrial broadcast delivery. It is technically conceivable that terrestrial broadcasting could be abandoned, leaving HDTV to be delivered exclusively by cable, satellite and fiber. Obviously, broadcasters would be disenfranchised by such an approach. Further it is not clear that the public interest would be served, since broadcasting provides:

- the only free (or advertiser-supported) source of television programming to the public
- the predominant source for production of local news and public-interest programming
- a licensed operation that serves the public interest under FCC regulation

It is important to observe that even without the restrictions of simulcasting, a higher-capability technical standard would not necessarily result, simply due to the low costs of communications and HDTV sets that are crucial to establishing a consumer market.

ALLOCATING MORE SPECTRUM TO HDTV IS IMPRACTICAL

Another response to the technical difficulties of simulcasting is to allocate a wider (> 6 MHz) channel for HDTV broadcasting. A wider channel might require a substantial reassignment of existing NTSC stations, as well as new spectrum being allocated for HDTV. Particularly due to the growing usage of land mobile communications, new spectrum is a highly contended-for resource. The alternative of granting fewer HDTV licenses would mean that all current broadcasters are not assured an HDTV channel, thus not serving the public interest (via restricting the avalailability of free over-the-air HDTV programming, reducing the production of local news and reducing the ranks of licensed broadcasting operations that serve the public). In addition, the practical ramifications of a wider channel on interference with existing NTSC service and HDTV service area that can be achieved remain speculative.

DELAYING THE HDTV STANDARD IS NOT IN THE NATIONAL INTEREST

By rapidly developing digital HDTV, the U.S. has played its trump card. Detailed descriptions of the forerunner systems and the new Grand Alliance system are in the public domain, as part of the open industry standards-setting process. A delay in establishing the U.S. standard will provide time for other countries to catch up, allowing them to more effectively compete for market share in the U.S. Furthermore, delay in promulgating the U.S. standard (or appropriate derivatives) worldwide will serve to deny foreign markets to U.S. companies. This impact will be felt by U.S. companies engaged in consumer electronics, integrated circuits, communications, and entertainment software production.

DEPLOYING HDTV WILL ACCELERATE THE NII

By deploying digital HDTV and creating a new consumer market, the U.S. can accelerate the development and consumer acceptance of the NII. HDTV can be delivered by existing cable television systems, and can soon be put on the air by broadcasters. HDTV will create a mass market for low cost, high resolution displays in agile receivers that have sophisticated digital circuitry. Adding a more powerful microprocessor (a simple one is already there for control purposes) to an HDTV set will yield an NII-ready information appliance at a small premium cost. Consumer acceptance of the NII may be best served by using entertainment as a catalyst for introducing the necessary capabilities into the home. However, this can only be successful if HDTV receivers are affordable. Further, some consumers will want this added capability, and some will not (e.g., it may not be desired by a consumer who is purchasing a small HDTV for the bedroom).

It is reasonable to expect that an HDTV receiver (even one with an interlaced display) can adequately serve as an entry-level NII terminal for a wide variety of consumer applications. Although not all NII applications are advantaged in this way, consumer acceptance and growing use of the NII will create market demand for more advanced HDTV receivers that have ever more capable processors and displays. Thus, HDTV can be an important catalyst to the development and acceptance of the NII. As the NII grows, so will consumer demand for ever more sophisticated HDTVs and other infomation appliances.